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CE 637-851: Short Span Bridge Design

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DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CE 637-851 Short Span Bridge Design / Fall 2020

Course Description:

The course covers the engineering process of short-span bridges from design to maintenance and rehabilitation. The various major forms of short-span bridges are presented with an emphasis placed on the most prevalent types and on highway bridges. The structure of a bridge, its superstructure and substructure members and other related elements such as abutments, foundations and retaining walls are discussed. Design procedures are covered based on the requirements of the AASHTO LRFD Bridge Design Specifications.

Prerequisites/ Required Skills:

Prerequisites: undergraduate courses in structural analysis, steel design and reinforced concrete design and some knowledge of prestressed concrete fundamentals.

Canvas:

Course will be delivered through Canvas at <https://Canvas.njit.edu>

Instructor:

Rima Taher, PhD, PE

Office: Weston 521 – Phone: 973-596-3015

Office Hours: Online by Teleconferencing or by Phone
Tuesday from 1:15 to 2:15 pm or by appointment

Email: Taher@njit.edu

Required Text:

Bridge Engineering by Demetrios E. Tonnias and Jim J. Zhao, 4th Edition, published by McGraw Hill, 2017, ISBN 978-1-259-64309-5.

An electronic version of the book can be accessed online free of charge through the NJIT library website at <https://library.njit.edu> by following these steps:

CE 637-851 Short Span Bridge Design - Syllabus

1. Click on the tab "Databases"
2. Click on "Databases: A to Z" and under "Subjects" select "Civil Engineering".
3. The first database under Civil Engineering is "AccessEngineering". Click on "AccessEngineering" and this will take you to the McGraw Hill "AccessEngineering" database.
4. Login to "AccessEngineering" using your university UCID and password.
5. You can find the book by entering the title or subject into the search box.

Please note that during the final exam, you will be locked into the exam web browser and will not be permitted to open the electronic book or any other electronic files. For this reason, the material you need for the final exam must be in print form only.

References Codes & Standards:

1. AASHTO LRFD Bridge Design Specifications, 8th Edition, American Association of State Highway and Transportation Officials, Washington, D.C., 2018.
2. Building Code Requirements for Structural Concrete and Commentary, ACI 318-19, American Concrete Institute, 2019.
3. Manual of Steel Construction, 15th Edition, American Institute of Steel Construction, 2016.

Course Sections:

Week	Date	Topic/Assignment
1	9/1 to 9/6	Introduction to the Course and Course Requirements – Introduction to Highway Bridge Structures: Use and Functionality, Typical Components, Bridge Terminology – Design Standards and Specifications
2	9/6 to 9/13	Design Loads: Permanent Loads, Temporary Loads, Deformation and Response Loads, Group Loading Combinations Tuesday September 8: Monday Schedule
3	9/13 to 9/20	Superstructure Types - Deck Types: Non-Composite and Composite Decks – Shored and Unshored Construction – Concrete Deck Slabs – Wearing Surface Types
4	9/20 to 9/27	Concrete Deck Slabs – Detailed Concrete Deck Design Example for a Slab-on-Stringer Bridge Project 1 Assigned
5	9/27 to 10/4	Bridge Failures – Case Studies - Videos
<u>6</u>	10/4 to 10/11	Project 1 Due Design of Composite Steel Members - AASHTO LRFD Design

CE 637-851 Short Span Bridge Design - Syllabus

		Method: Design Truck or Tandem, Wheel Load Distribution Factors, Effective Flange Width, Dynamic Load Allowance, Placement of Design Truck on a Span, Composite Section Strength, Shear Capacity, Transformed Section, Shear Connector Design, Fatigue, Additional Constraints - Detailed Design Example of a Composite Steel-Concrete Stringer
7	10/11 to 10/18	Design of Composite Steel Members - AASHTO LRFD Design Method (Continued)
8	10/18 to 10/25	Design of Composite Steel Members - AASHTO LRFD Design Method (Continued)
9	10/25 to 11/1	Design of Composite Steel Members - AASHTO LRFD Design Method (Continued) Project 2 Assigned
10	11/1 to 11/8	Continuous Bridges: Advantages and Disadvantages, Rolled Sections as Continuous Beams, Moment Distribution Method, Examples
11	11/8 to 11/15	Last Day to Withdraw: Monday November 9 Plate Girders: Elements of a Plate Girder (Flanges, Web, Stiffeners, Lateral Bracing), Hybrid Girders - Detailed Design Example of a Two-Span Continuous Plate-Girder Bridge
12	11/15 to 11/22	Prestressed Concrete Bridges Bridge Inspection Project 2 Due
13	11/22 to 11/29	The Substructure Elements: Abutments, Foundations, Piers and Bearings – Overview of Abutment Design Wednesday November 25: Friday Schedule Thursday November 26 and Friday November 27: Thanksgiving Recess – No Class
14	11/29 to 12/6	Protecting the Superstructures: Inspection, Rehabilitation and Maintenance Issues
15	12/6 to 12/13	Review for the Final Exam Last Day of Class at NJIT: Thursday December 10 Reading Day 1: Friday December 11 Reading Day 2: Monday, December 14

CE 637-851 Short Span Bridge Design - Syllabus

	Final Exam Week: From Tuesday December 15 to Monday December 21
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Grading Policy:

Project 1: 30% - Concrete Slab Deck Design for a Slab-on-Stringer Bridge – Tentative Due Date: Friday, October 16

Project 2: 35% - Design of a Typical Composite Stringer for a Highway Bridge –Tentative Due Date: Friday, November 20

Online Final examination: 35% - During the final exam week, from December 15 to December 21st

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Grading Scale:

A:	100-90
B+:	89-85
B:	84-80
C+:	79-75
C:	74-70
D:	69-60
F:	Below 60

Attendance Policy:

Lectures will be posted online twice per week. Students must login to the Canvas course-page to view the posted lectures and do the related work at their earliest convenient time after getting notified that some new material has been posted. The instructor will verify the attendance using the features available on Canvas to track the student's attendance and online activity in the course.

Withdrawals:

In order to insure consistency and fairness in application of the NJIT policy on withdrawals, student requests for withdrawals after the deadline will not be permitted unless extenuating circumstances (e.g., major family emergency or substantial medical difficulty) are documented. The course Professors and the Dean of Students are the principal points of contact for students considering withdrawals.

CE 637-851 Short Span Bridge Design - Syllabus

NJIT Honor Code:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.

*Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.** If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu*

Course Delivery and Requirements:

Canvas will be used to deliver the course material. The final exam will be given online on Canvas. Students will have to submit the course projects using Canvas as well. The Canvas site is <http://canvas.njit.edu>. Students need to login with their UCID and password. Generally, lectures will be posted twice a week on Monday and Thursday. An email notification will be sent to the class via email or by posting on the course Forum by the instructor after a new lecture or some new material is posted. Students must check their NJIT email and the Canvas course-page on a regular basis.

Students are required to submit two projects and to take a final exam in addition to a few informal homework assignments. For the online final exam, the course requires the use of the Respondus LockDown Browser and Respondus Monitor + webcam, as it will be indicated prior to the date of the exam. Instructions and video lectures will be posted online to explain the procedures and how to use these testing tools and systems.

Students will have 3 hours for the final exam. Students will not be permitted to email the projects, the exam or any part thereof directly to the instructor. The student work must be stored on Canvas and any emailed project or exam files will be declined and deleted.

Tentative due dates are given in this syllabus. Due to the nature of the material in this course which is not suited for multiple-choice test questions, and after discussing this matter with the program director at the civil engineering department, it was determined that the most logical and most suitable format for the exam in this course is to set a window of 3 hours for the students to take the exam online. All students are expected to take the exam online at the same time. The exam will consist of a few problems to solve. Students are supposed to show the calculation work done to solve the problems. The exam date and time will be scheduled by the Registrar's Office during the final exam week (December 15 to 21).

Students who have a conflict with project due times or the time of the final exam must contact the instructor. Students must have a valid excuse to get an extension on a project deadline or to reschedule the exam time. All excuses must be substantiated. Please note that business and vacation trips are not considered as legitimate excuses. Illnesses and other issues must be dealt with by the Office of the Dean of Students who will determine whether the excuses are legitimate or not. Students who do not show up online as scheduled for the final exam will not get a make-up exam unless they have an excuse that can be substantiated.

CE 637-851 Short Span Bridge Design - Syllabus

Students enrolled in this course should not schedule vacation and holiday trips while the course is ongoing and on dates that coincide with test dates. The course will end after the final exam is given. Airline tickets must not be booked before the final exam date. The final exam week is from December 15 to 21.

Assignment Policy:

The project outlines will be posted on Canvas. A PDF file outlining the project will be posted, and a link will be created on Canvas for the students to upload the project file by the due date and time. Students must have access to a scanner to scan their solution pages. All pages must be combined into a single PDF and uploaded to Canvas. Students are not to post files in formats other than PDF. The instructor must be able to open and read the files. If the file is corrupt or illegible, and the instructor is unable to read the file, the student will receive an F grade for that assignment. Students should not email the assignments directly to the instructor.

In addition to the formal projects, some informal homework problems and exam review problems will be posted by the instructor. It is important that students attempt to solve those problems before the solution is posted. Students do not have to upload any informal homework problems and exam review problems. However, it is necessary for the students to solve these problems on their own first, because these informal problems are an integral part of the course material and are needed for a proper learning of the covered topics.

Syllabus Information:

The dates and topics of the syllabus are subject to change; however, students will be consulted with and must agree to any modifications or deviations from the syllabus throughout the course of the semester.

Email Policy:

Students may email their questions to the instructor however the instructor encourages the students to post any questions related to the course material to the Forum on the Canvas course-page. Posted questions and answers will be seen by the entire class.

Items Required for this Course:

1. A copy of the textbook in print. Students should not get an electronic copy because they will be locked in the test browser during tests, and will not be permitted to open electronic files.
2. A regular scientific calculator. Cell phone calculators and other electronic devices will not be permitted during the test.
3. Test monitoring requires a webcam. The student must use a computer that has a built-in webcam otherwise the student must get a webcam and install it on the computer.
4. Students must have access to a printer and scanner, or a printer with scanning capability.

Outcomes Course Matrix –

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Introduce the students to the various types of bridges, the related engineering codes and standards and the types of loads used to design bridges			
Learn about Highway Bridge Structures: Use and Functionality, Typical Components, Bridge Terminology – Design Standards and Specifications – Design Loads and Group Loading Combinations	1, 2, 4, 7	1, 2	Lectures and discussions
Student Learning Outcome 2: Learn about the various deck types in bridges and how to design a typical concrete deck slab			
Learn about Superstructure Types - Deck Types - Concrete Deck Slabs – Detailed Concrete Deck Design Example Learn about Elements of the Substructure	1, 2, 4, 7	1, 2	Project, class lectures and discussions

CE 637-851 Short Span Bridge Design - Syllabus

Learn about Issues of Bridge Inspection, Maintenance, Rehabilitation and See cases of Bridge Failures			
Student Learning Outcome 3: Learn how to design composite steel members for a slab-on-stringer bridge and steel plate girders for continuous bridges			
Design of Composite Steel Members - AASHTO LRFD Design Method:- Detailed Design Example Design of Plate Girders for Continuous Bridges – Detailed Design Example	1, 2, 4, 7	1, 2	Assignments, tests and class lectures and discussions

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our Program Educational Objectives are reflected in the achievements of our recent alumni:

1. Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
2. Professional Growth: Alumni will advance their technical and interpersonal skills through professional growth and development activities such a graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.
3. Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

CE 637-851 Short Span Bridge Design - Syllabus

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies